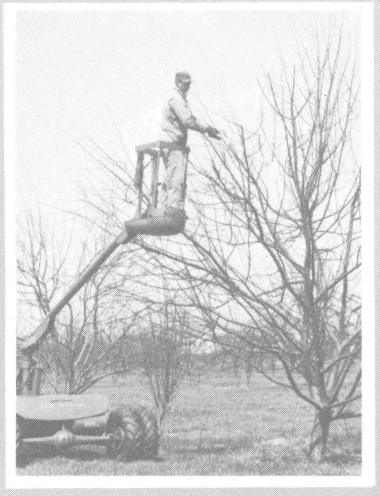
PRUNING AND TRAINING FRUIT TREES



COOPERATIVE EXTENSION SERVICE
THE OHIO STATE UNIVERSITY

CONTENTS

Authors

Eldon S. Banta, Extension Horticulturist
The Ohio State University and Cooperative Extension Service

Freeman S. Howlett, Professor Emeritus
Department of Horticulture, The Ohio State University and The Ohio Agricultural Research and Development Center

Robert G. Hill, Jr., Professor, Department of Horticulture, The Ohio State University and The Ohio Agricultural Research and Development Center

Acknowledgment

The authors express appreciation to Professor Fred O. Hartman, Department of Horticulture, The Ohio State University and The Ohio Agricultural Research and Development Center and to Mr. John T. Yoder, Jr., Department of Horticulture, The Ohio Agricultural Research and Development Center for their helpful suggestions and assistance in reviewing the manuscript for this bulletin.

6/70—10M

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roy M. Kottman, Director of the Cooperative Extension Service, The Ohio State University.

PRUNING AND TRAINING FRUIT TREES

Pruning and training fruit trees is done to facilitate production of the greatest yield possible of quality fruit. This practice is necessary to develop a strong framework, which increases the life of the tree and reduces the loss from wood breakage. Improvement of fruit quality depends, in part, on proper pruning.

The kind and amount of pruning is largely determined by the kind, age, and cultivar[1] of fruit trees. Also, the existing framework, tree vigor and health, and growth and fruiting habits must be considered. Avoid heavy pruning of young trees because it may delay the time of bearing from 1 to 3 years. On the other hand, neglect of pruning during the first 3 or 4 years can result in development of a poor framework with weak, narrow-angled crotches. Careful training techniques are essential during the first few years to develop a desirable framework and tree shape. Once the basic tree form has been achieved, light, corrective pruning is desirable each year until the tree begins bearing.

Insufficient pruning of bearing trees may result in small fruit of poor color, low sugar content, and mediocre flavor. Trees that are over-pruned may also produce poorly colored fruits, although they may be of large size. Such fruits usually have large, soft cells and consequently a short storage life.

Seasons for Pruning

Most orchardists prune during the dormant season. At that time, other orchard operations are less pressing and undesirable branches can be more easily detected. Dormant trees are not easily "barked" by men climbing on the branches and, during the dormant season, bark seldom pulls away from pruning wounds.

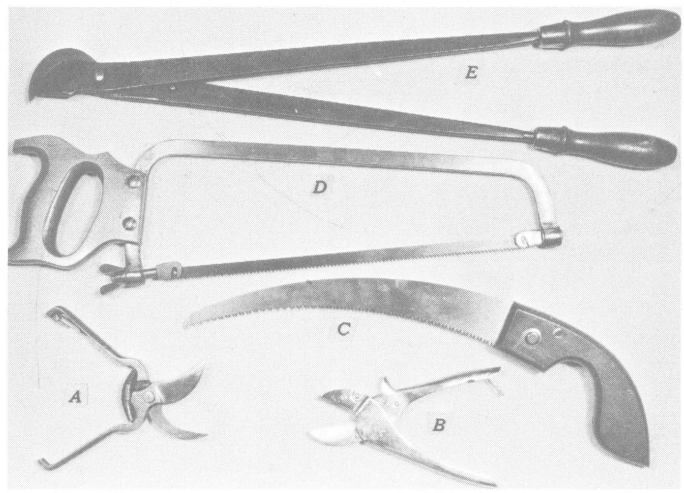
The best time to prune is early spring just prior to the beginning of active growth. At that time, wounds heal most readily and flower buds can be easily detected, enabling quick determination of the location and number of cuts. This is especially true in pruning peach trees. However, the pruning of large orchards must be started earlier in order that the job can be finished in time for early spraying.

Low temperature injury is the major risk with fall or early winter pruning in Ohio. Trees that have been pruned before severe weather are often seriously injured by sub-zero temperatures that follow. Pruning in November and December can be more hazardous to trees than pruning in late February, March or early April.

Summer pruning is not generally recommended since it causes more dwarfing of the tree than dormant pruning. If a dwarfing effect is desired, then summer pruning may be practiced. Water sprouts may be removed in June and July, when 6 to 10 inches long, either by hand or with shears. Removal of water sprouts at this time keeps the tree open and reduces the amount of dormant pruning later. Also, summer aphid problems are reduced when these succulent shoots are removed.

Pruning Equipment

For the small orchardist and the home fruit grower, hand tools provide the best and most economical pruning equipment. Hand shears, lopping shears, pole pruners, and pruning saws of various sizes and styles are available. Each tool will perform well if properly used and the cutting edges are kept sharp.



Small cuts are made with hand shears. The type hand shears at the left, A, makes snug cuts for all light pruning. The "roll cut" type, B, handles small twigs very easily and is useful for detail pruning.

Curved saw, C, which cuts on a draw or pull stroke, works fast on larger limbs but does not make as clean cuts as D. The curved saw speeds up peach pruning. The swivel-blade orchard pruning saw, D, makes a clean, close cut in narrow crotches and at difficult angles.

The steel-handled lopping shears, E, are indispensable in peach pruning and are useful for mature apple trees where many limbs over an inch in diameter must be cut. Care in placing the blade of lopping shears against the supporting limb will make a snug cut.

[1] The term cultivar replaces the older word, "variety," throughout this bulletin.

Hydraulically-controlled towers and pruning equipment increase worker efficiency. This equipment operates from the tractor hydraulic system.

Small power saws hasten removal of large limbs.

Platforms from which pruning is done are still in common use.

Power Pruning

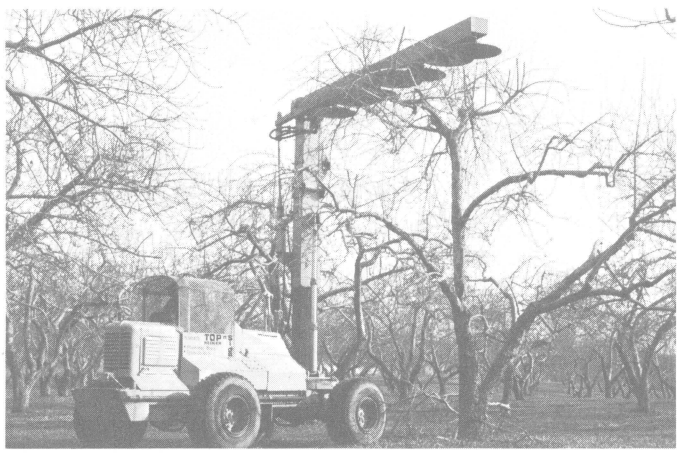
Commercial orchardists have adapted various types of power-operated equipment to make the pruning operation easier, quicker, and more efficient. Most power pruners work on the principle of compressed air activating a piston which operates the shear head. Power saws are in use which operate on the same principle. Some power pruners operate from the tractor hydraulic system instead of using compressed air.

Small, powered chain saws are also used in orchard pruning. These saws are especially useful in orchards when rather large cuts must be made.

Along with the use of power pruners has come the use of various types of platforms and mobile towers from which the pruning is done and which move the workmen through the orchard. Such equipment is commercially available, although some growers have built their own. Development and use of such equipment have increased the efficiency of power pruners, hastened the pruning work in large orchards, and made the entire job easier.

The use of pruning platforms and hydraulic towers makes possible the pruning of a tree from the outside toward the center. In this way, the outer and higher branches can be thinned easily and effectively. As a result, more light may penetrate the interior of a tree, inducing more productive wood in this area. The net result is greater exposure to light of the entire leaf and fruiting areas of a tree, which increases production of well-colored, high quality fruit per tree. Use power pruners with caution as over pruning and improper cuts can be so easily made.

Hedging machines are of more recent origin and use in deciduous orchards. This type of machine can be used to do gross pruning in a short period of time, such as lowering tops of trees and shearing their sides. Hedging is not a method of selective pruning; consequently, orchards that have been so pruned still need some detailed pruning by hand or power shears. If such detailed pruning does not follow hedging periodically, at least every other year, then trees may grow dense and bushy in the outer areas. When this happens, fruit of poor color is produced in the interior of trees. Hedging combined with a good annual selective pruning program can result in important time and labor savings, especially in large orchards.



Hedging and topping machines of various types are being used to do bulk pruning in large orchards.

Making the Cuts

All cuts should be made with sharp tools correctly adjusted. These give clean, smooth cuts. In removing a branch, make the cut close to and parallel with the supporting limb. When heading back to a lateral, place the cut so it continues somewhat the line of direction of the lateral branch. Stubs do not heal and may start decay. If the cut is too close to the point of lateral attachment, the branch is likely to split out.

In using shears, place the blade against the supporting limb to allow for a smooth, close cut. The cut can be made easier by pushing slightly downward on the branch in the direction the cut is being made. Never wiggle the shears through a cut, as this makes a ragged wound that will heal slowly, and may spring the shears.

In removing a large limb with a saw, it is often helpful to do so with 3 cuts. First, make an under-cut 1 to 2 inches deep and about 8 to 10 inches out from the base of the limb. Then cut from above starting the second cut 2 or 3 inches nearer the base of the limb than the under-cut. Thus, the limb will fall without tearing the bark down into the supporting limb. Remove the short stub with a close cut made against the supporting limb.

Wound Dressing

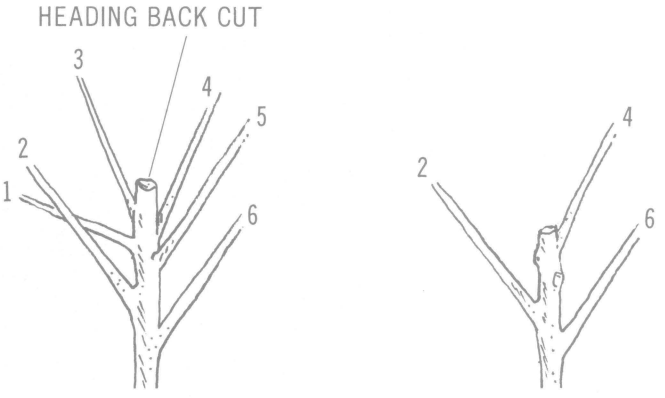
There is no particular advantage in applying a dressing to wounds under 2 inches in diameter. A wound dressing applied to larger wounds aids in the healing process. The preferred wound dressing has an asphalt base, although others may be used. Paints with lead or zinc are satisfactory. Wound dressings containing bordeaux mixture may injure the cambium and interfere with natural healing processes. The same is true of creosote paints.

Pruning as Related to Growth and Production of Young Trees

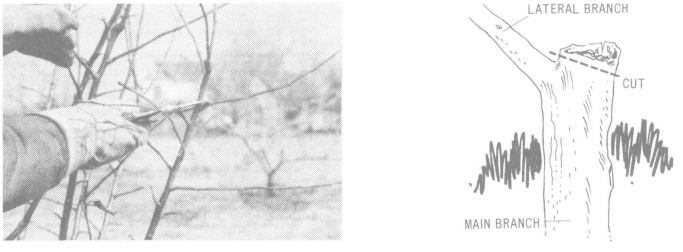
Pruning has a dwarfing effect upon trees, as has been demonstrated at the Ohio Agricultural Research and Development Center and elsewhere. All leaves on a tree contribute food necessary for growth, and any pruning reduces the leaf surface. With young trees, prune only enough to train the tree. Every unnecessary cut is an economic loss.

Research in Ohio and other states has shown that heavily pruned trees are smaller and do not come into bearing as early as those pruned lightly or not pruned. Unpruned trees, while larger, are ungainly and have many framework defects. Lightly pruned trees develop best. Golden Delicious and others that come into bearing early are less affected by severe pruning than are such cultivars as Delicious and its mutations which come into bearing later. Unnecessary wood removed in the name of pruning will reduce yields.

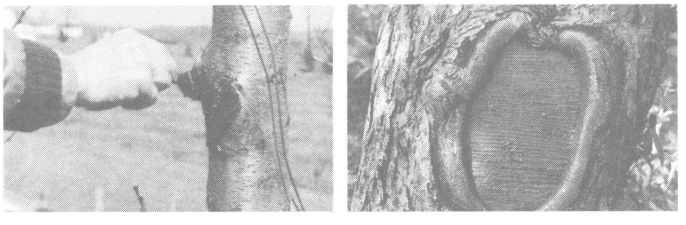
A weak crotch usually results when one branch grows from another at a very narrow angle. Crotch weakness may also occur when 2 or more branches of the same size originate adjacent to each other. The weakness in narrow crotches results from the development of bark inclusions as the tree grows. When crotches are narrow but with no bark inclusions, the branches are quite strong.



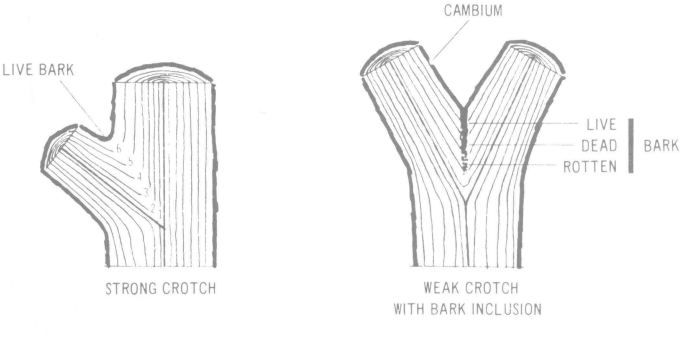
Left, the heading back cut forced several buds below it into vigorous growth. A number of such cuts can result in a very thick tree with much unproductive wood. Right, when a condition develops as shown at left, prune out laterals with narrow crotches. Leave only 2 or 3 well-spaced branches as shown here.



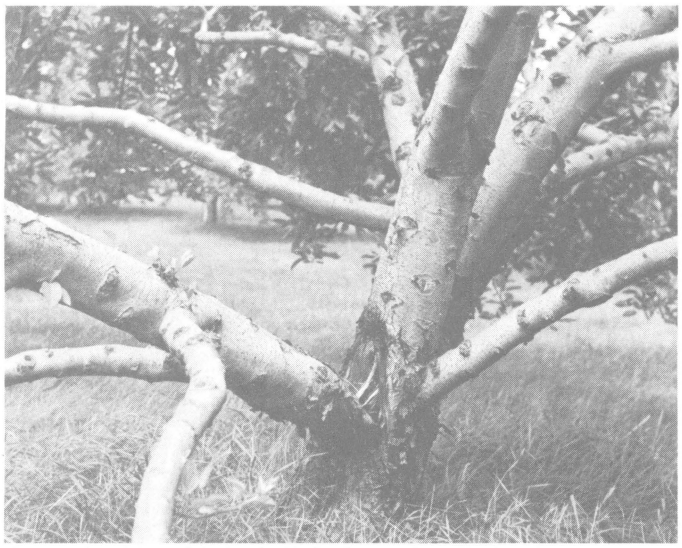
Left, a heading-back cut is made just above a strong, outward-growing lateral. Right, cut above the lateral was improperly made and left too high a stub. Dotted line represents angle and position at which cut should have been made.



Left, wounds larger than 2 inches in diameter are best treated with a suitable wound dressing. Right, wound resulting from proper removal of a large branch heals quickly.



Wide crotch angles insure strength. The angle of the crotch on the left is wide. Note relative thickness of the 6 successive layers of wood (numbered) laid down by the cambium in this crotch angle. At right, angle at the crotch is narrow. Bark in the crotch angle comes together before the crotch is filled with woody tissue. This prevents union and encourages decay. A narrow crotch is weak, splits with overloads, and is often associated with winter injury on adjacent bark.



Weak crotches with bark inclusions often split out when trees become productive, thus causing tree loss.

It is often desirable or necessary to remove entirely certain branches when they develop very narrow angles. If the branch is well located with respect to the general periphery of the tree, it may be headed back severely, thus dwarfing the branch. Eventually it may be removed entirely from the tree, especially if another lateral develops which may be used to replace it.

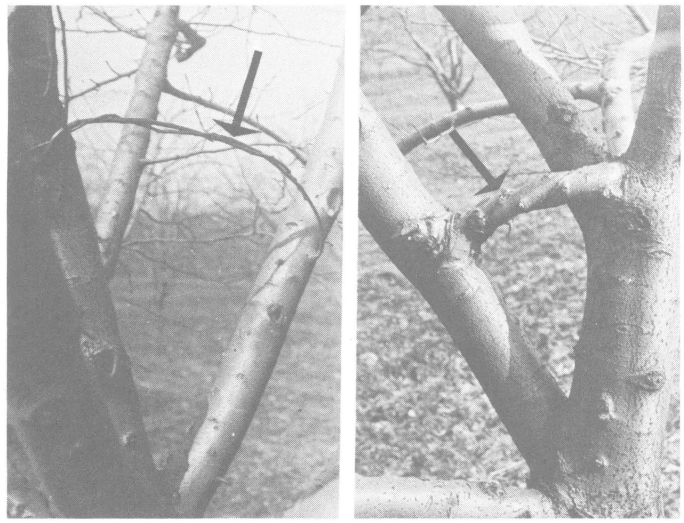
Failure to train a tree properly during the first few years may eventually result in loss of the tree due to severe breakage.

Pruning as Related to Tree Size and Planting Distance

The present day practice is to grow smaller trees with a greater number per acre of orchard. This is particularly true for apples and, to some extent, other fruit trees. As such trees reach mature size, it is often necessary to increase the amount of pruning in order to keep them within desired size limits.

Pruning to maintain tree size is largely a matter of judicious heading back of longer terminal growths to keep fruiting wood nearer the interior of the tree and distributed throughout the volume of the tree. In controlling mature tree size, it is essential to accurately regulate the supply of nitrogen to the tree. Excessive nitrogen can result in vigorous growth and more pruning. Rates of nitrogen application should be adjusted to the amount of terminal growth and foliar analysis results of the preceding season. Remove all water sprouts or short growth from the rootstock below the graft or bud union.

A modern "high density" orchard on size-controlling rootstocks has 200 trees or more per acre.



Note the two water sprouts which have been intertwined and tied to form a natural graft brace limb to strengthen a weak crotch. In subsequent growth, a strong permanent brace limb is developed as shown at right. Caution pruners not to cut these branches off as freaks.

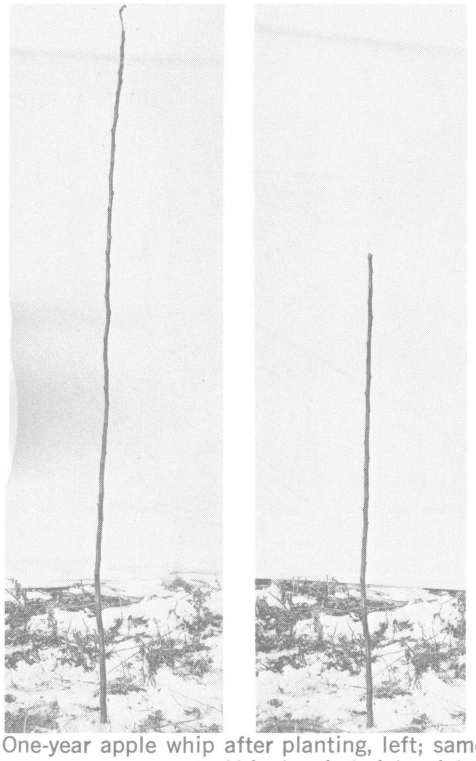
Training Fruit Trees

Modified Central Leader System

Experience and research have shown the modified central leader system of training to be quite satisfactory for standard size fruit trees. It is especially suitable for apple and pear trees. This same system of training may be followed with semi-dwarf and dwarf trees at wide spacings. However, in dense plantings other systems may be more suitable.

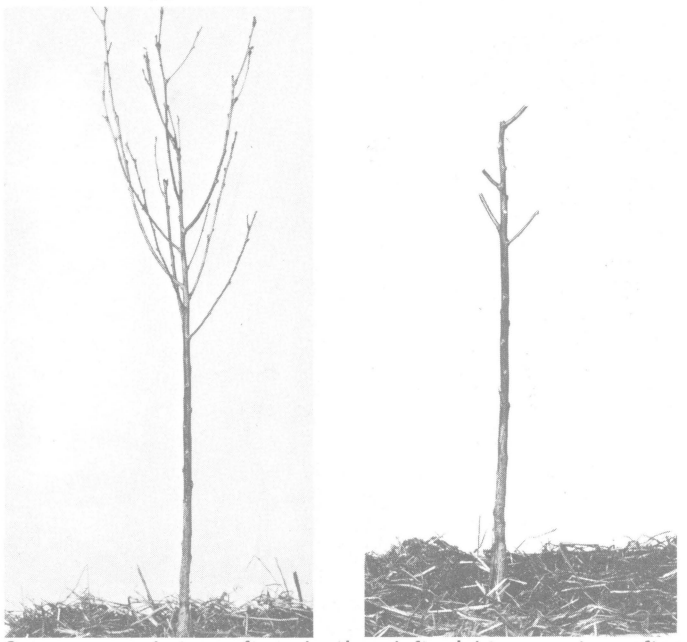
At Planting: When possible, it is best to plant 1-year-old unbranched trees of larger sizes. Standard trees about 11/16 inch in diameter and 5 to 7 feet tall are best. This permits heading standard trees to 44 inches after planting. This height allows for adequate vertical spacing between the laterals to be selected for framework development.

Abundant fruiting spurs throughout this apple tree is the result of proper heading-back and thinning of branches.

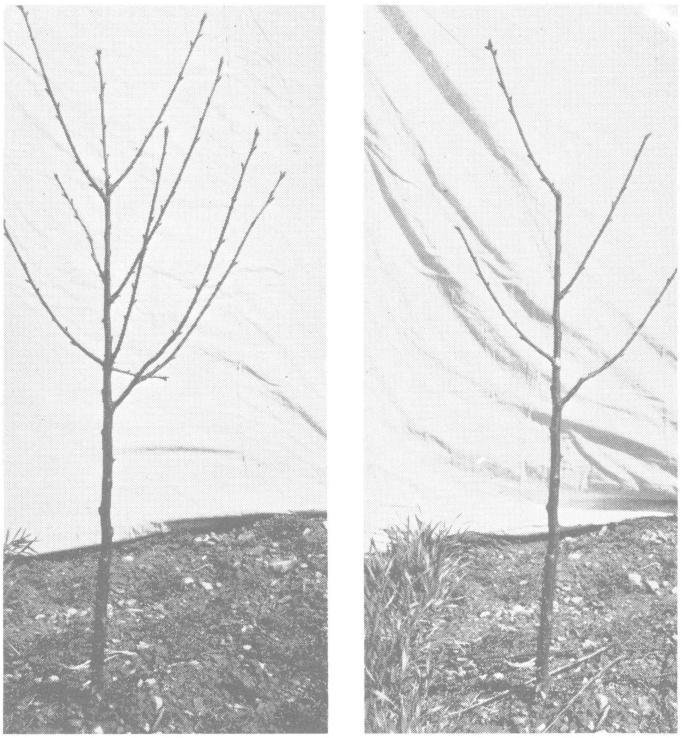


One-year apple whip after planting, left; same tree after cutting to 44 inches in height, right.

Apple trees on size controlling rootstocks as well as stone fruit trees may be pruned essentially the same as standard trees. Dwarf trees on the EM (East Malling) IX or EM 26 rootstocks may be headed back to a point 28 to 30 inches above the bud or graft union, if low-headed trees are desired. Spur type trees and semi-dwarf trees on EM VII, EM II, MM 106, MM 104, and MM 111 are headed to a height of 36 to 40 inches above the bud or graft union. Stone fruit trees would be headed at heights similar to semi-dwarf apple trees.



One-year peach tree after planting, left; right, same tree after pruning for developing an open-center framework.



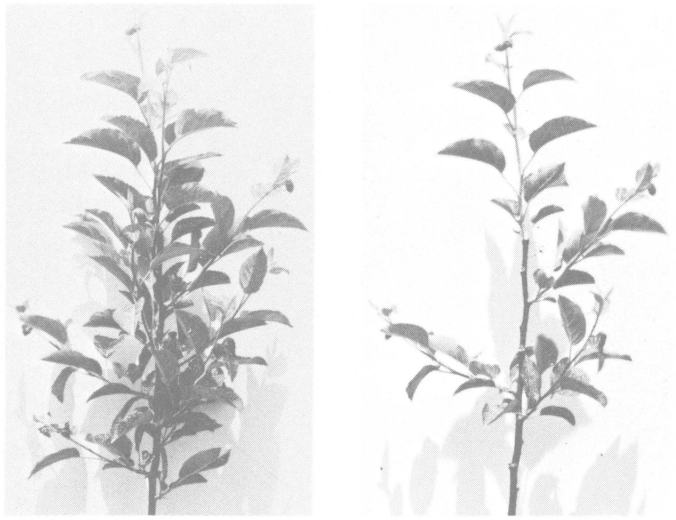
A one-year-old Montmorency cherry tree at planting. Left, before pruning, and right after pruning and selection of four well-spaced branches for the primary scaffolds.

If branched 1- or 2-year-old trees are planted, as is often the case with peaches and cherries, then pruning involves selecting the most desirable laterals and removing all others. Selected laterals should have as wide-angled crotches as are possible with the cultivar at hand. They should be 8 to 10 inches apart vertically, each occupying a different sector of the tree. With some trees, none or only 1 lateral may be suitable enough to remain. In other cases, 2, 3 or 4 may be satisfactory the first year for developing into the primary scaffold branches. Only 4 should be left for primary scaffolds. These are cut to disproportionate lengths. The leader, or top lateral, is usually left about twice as long as the longest side lateral.

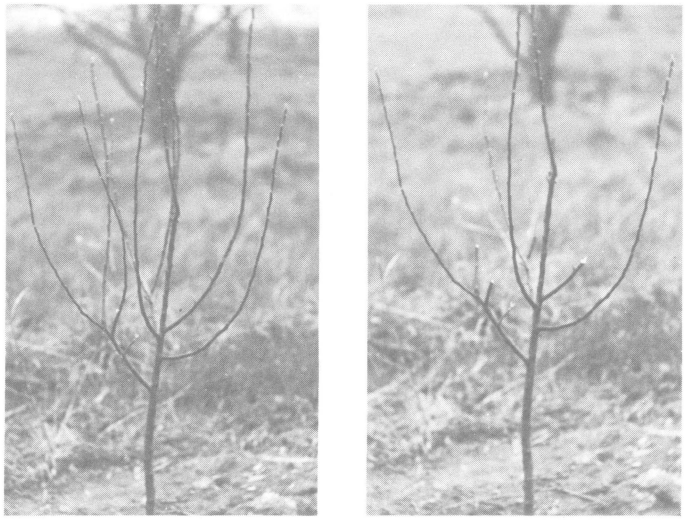
Small size 1-year-old trees are less desirable than larger ones, but sometimes they may be all that is available. Such trees should be headed back to more mature wood depending on height of whip. Only one lateral branch is allowed to grow into the leader the first year. The second year, training may begin as described above, or in the section on deshooting.

Spreading: It is most important to have the lower scaffold branches grow in a somewhat horizontal position to promote early bearing and reduce extension growth. Therefore, it is essential to spread these laterals in the manner described on pages 10 and 11. If sufficient growth is made, spreaders can be put in place during the summer following planting. Usually they are first inserted at pruning time the following spring.

Deshooting—An Alternate Training Technique: Results of experiments at the Ohio Agricultural Research and Development Center show that removal of undesired shoots during the first growing season is most helpful in proper training of fruit trees. All new shoots are allowed to grow



One-year apple tree deshooted during the first growing season. Left, before deshooting; right, after deshooting with four branches remaining to develop into the primary scaffold branches for a modified central leader tree.



Pruning apple tree after first growing season. Before pruning left; after pruning, right, with branches for primary scaffolds remaining.

on the tree until early or mid June. At this time 3 to 4 shoots, properly spaced vertically and around the trunk, are selected to become the main framework. All others are promptly removed or pinched back to reduce their growth and competition with the selected scaffold branches. The shoots remaining for the main scaffold branches should have the widest angles possible, preferably greater than 45 degrees. It may be necessary to go over the trees again a month later and remove or pinch back any new shoots that arise from the trunk, as these may interfere with growth of the main branches.

On small trees, only 2 or 3 laterals may be selected the first year. The remaining 1 or 2 are chosen from shoots that develop the second year higher on the trunk.

Spring Pruning: Pruning after the first season's growth involves the selection of primary scaffold branches. Ideally, the 4 lateral branches chosen for the framework should be spaced where possible 8 to 10 inches apart vertically on the trunk, the lowest being at least 24 inches above the ground. Each lateral should occupy a quarter sector of the tree, and it may require 2 seasons to grow and select proper branches.

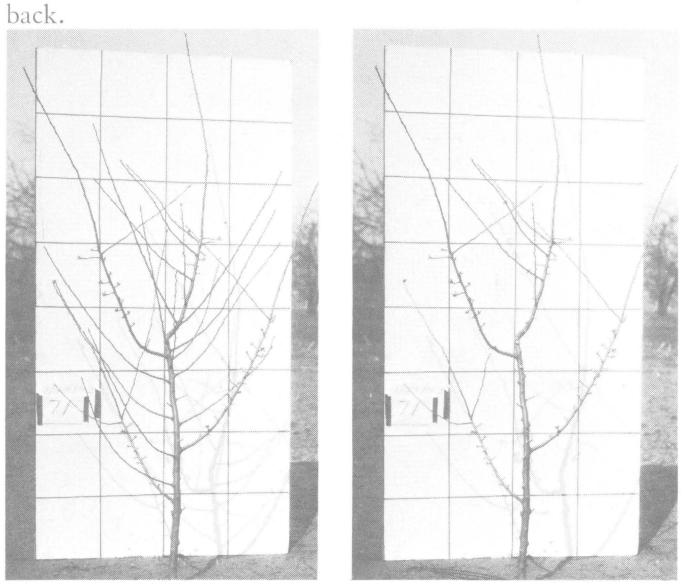
It may also be necessary at this time to change the framework of the tree and select one or more laterals that are better located. At this first spring pruning, all branches not needed for scaffolding should be pruned from the trunk.

If a weak crotch develops between a scaffold branch and the main trunk, removal is desirable. A more suitable lateral may then be selected from growth made the first year. If a lateral makes exceptional growth, to the point of being as long as the leader, remove from ⅓ to ½ its length, thus dwarfing its growth. This will allow the leader to maintain its dominance with respect to the other scaffold branches.

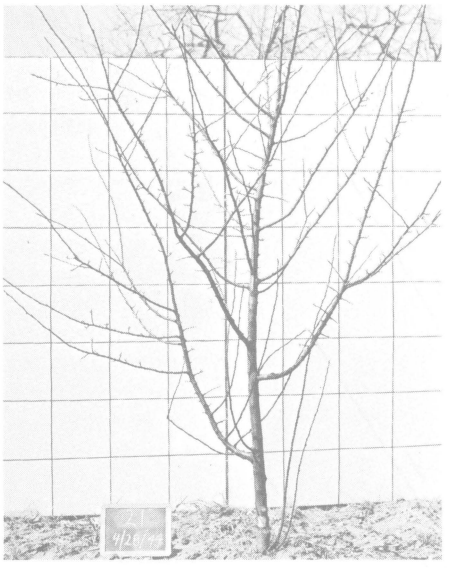
Second Year to Bearing: If the newly-planted tree is properly trained during the first 2 years, little pruning will be necessary for the next 4 to 5 years. During this period, training is still important in order to maintain the shape of the tree through optimum and balanced growth of the main scaffold branches.

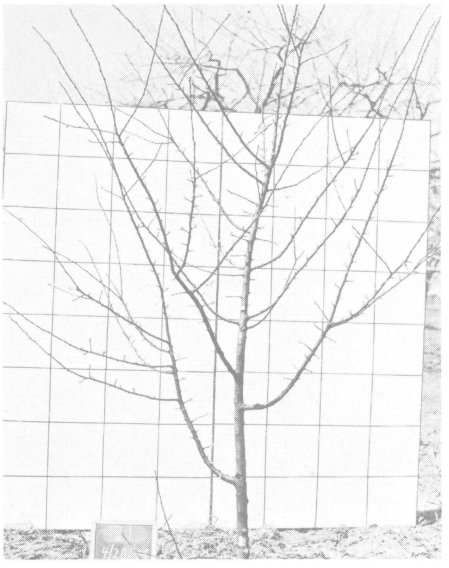
The leader or any scaffold branch should not be allowed to completely dominate the growth of the tree to the point where another scaffold is dwarfed. An over-vigorous scaffold branch should be headed back, possibly ⅓ or ½ its length. If it has branched, removal of side branches will retard its growth. In this manner the leader may be maintained as the dominant scaffold in its relative growth position.

Pruning during the pre-bearing, and even early bearing years, involves the removal of cross branches, those that rub together, water sprouts, and some small branches from the interior of the tree. Branches growing in undesired directions should be removed completely, or cut back to a lateral growing in a desired direction. Any branch that is interfering with the development of a primary scaffold branch or leader should be removed or severely headed back.

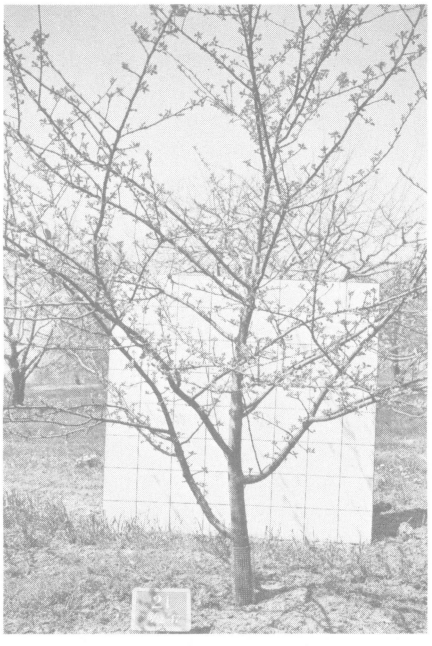


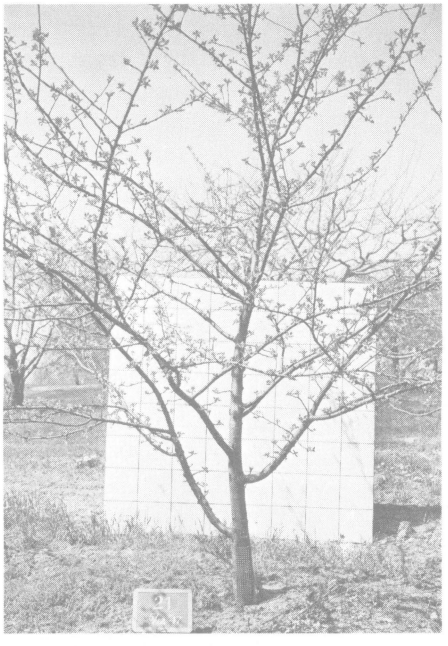
Stayman Winesap apple tree after two years' growth in the orchard; left, before pruning and right, after pruning. Note that branches from the main trunk which compete with the main scaffolds have been removed.



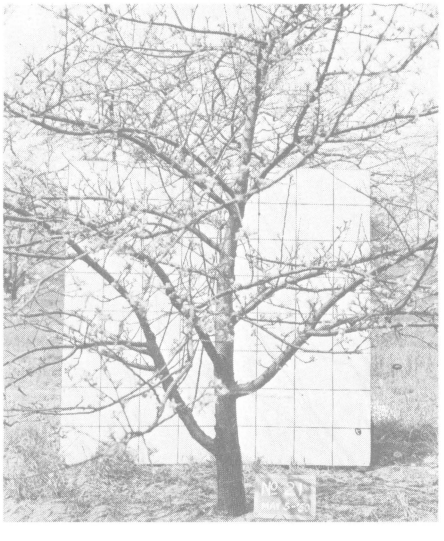


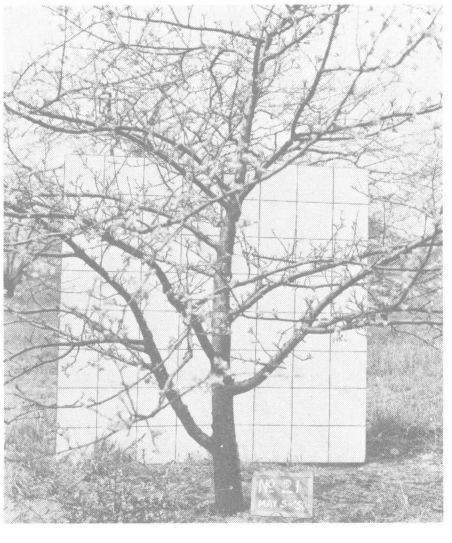
Right, a Stayman Winesap tree after four years growth in the orchard; left, before pruning and right, after pruning. Note that the center of the tree has been kept open while little pruning has been done on the lateral branches.





Left, the same tree as above after 7 years growth in the orchard; left, before pruning and right, after pruning. It is especially important during the early years of tree forming to remove as little wood as possible. The more severe the pruning, the later the trees will reach bearing age.

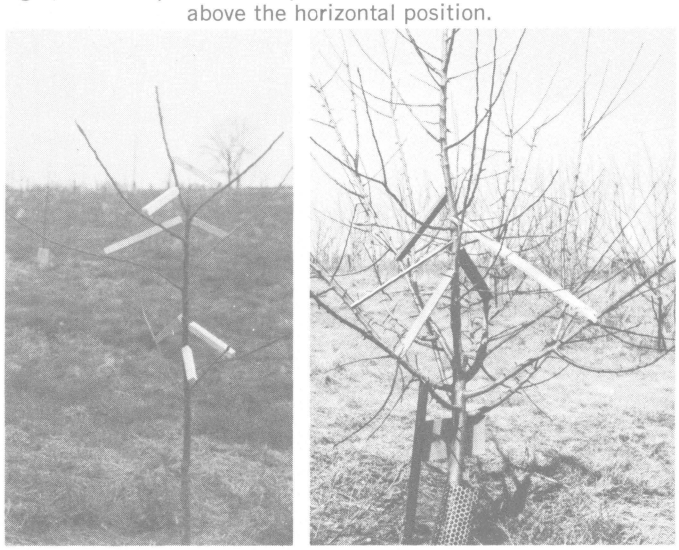




Right, the same tree as above after 10 years growth in the orchard; left, before pruning and right, after pruning. Even at this bearing age, very little wood should be pruned out annually. Removal of a small amount of wood each year maintains a better shaped and more productive tree than severe pruning every 2 or 3 years.

Spreading the branches of young trees has become a useful training technique. Here's one type of speader sticks being inserted in an apple tree after one year's growth in the orchard.

Apple tree after one season's growth in the orchard is ready for spreading and training to the central leader form. The same tree, right, with 7 spreaders in place. Branches are bent to a little above the horizontal position.



The same tree after light heading back of the leader and the upper vigorous lateral to supress its growth in relation to the leader. A 3-year-old apple tree, right, with larger spreaders inserted.

Central Leader System

The trend in recent years toward closely spaced plantings of apple trees and, to some extent, other fruit trees has resulted in a renewed interest in the central leader system of tree training. Interest in this system has also been enhanced by the extensive use of size-controlling rootstocks and spur type trees of certain apple cultivars. In addition, research on exposure of tree foliage to light indicates the central leader tree to be quite efficient. When shaped to a pyramidal form and held within given size limits, the central leader tree tends to expose a greater percentage of its foliage and spur-bearing surface to light than trees trained to most other forms. This consideration becomes most important in training and shaping trees in high density plantings (200 trees or more per acre).

The central leader tree is trained in a manner that permits the development of several scaffold branches from a central system. Two general concepts are in use. One utilizes all the lateral branches developing from the central stem as the young tree grows. Later, as the tree becomes thick, lateral branches are thinned by cutting a portion of them from the trunk. When the tree reaches the desired height, the central stem is cut to a short lateral branch and this height maintained for the life of the tree.

The other concept involves pruning lateral branches annually from the main stem in a manner that those remaining are in layers. Each layer may be 20 to 25 inches above the one below, and will be one year younger. When the tree reaches the desired height, the central system is cut to a short lateral branch, and this height maintained in succeeding years. The central leader tree is maintained in a pyramidal shape, regardless of the initial training method.

Spreading—A Training Technique: Spreading the branches, especially the primary scaffolds, of young fruit trees can aid in bringing about earlier fruit production and improved tree form. The technique involves bending upright growing branches down to a near horizontal position and holding them there.

Vigorous growing lateral branches can usually be positioned during the first growing season. Stiff steel wire cut with sharp points and in desired lengths can be used to hold branches in place. These usually need to be left in for 2 or 3 growing seasons before removal. By then the branches will be stiff enough to remain in position.

Branches 2 or 3 years of age can often be bent into an appropriate position and held there with properly cut lengths of wood. One method is to use wood pieces ¾ inch square, cut to desired lengths. In each end of the spreader stick, drive a 4- or 5-penny nail in to half its length. Cut the head of the nail off at an angle, leaving a sharp point. The pointed nail in each end is used to hold the spreader in place. Inspect trees frequently and replace spreaders if dislodged or otherwise removed. After 2 or 3 years, the spreaders may be removed.

Spreading the branches of young trees is especially desirable on all those with a distinct upright growing habit. It is an essential practice with most spur-type apple trees and such cultivars as Delicious, Rome Beauty, Ruby and others with a vigorous, upright growing habit. Spread-

ing can be of benefit on young pear, sweet cherry and possibly other fruit trees. Its value on peach and red tart cherry trees at this time is doubtful, in view of other training systems in use for these fruits.

Branches growing in an upright position tend to be vegetative and unfruitful for a longer period of time than those growing in a more horizontal position. The reason for this is related to the natural growth-regulators in the tree. Thus, spreading the branches of a young fruit tree favors initiation of spur growth and flowers.

At Planting: A newly planted, unbranched tree is headed 28 to 30 inches from the ground, or 2 to 3 inches above the point where the lowest scaffold branches are desired. The uppermost bud remaining will usually develop into the central leader and continue extension of the central stem. The next 2 or 3 buds will usually develop into suitable scaffold branches.

Second Spring: The first step is to insert the necessary spreaders if this has not already been done. Next, the central leader is headed just above the point where a new set of lateral branches is desired. Growth from the uppermost bud adjacent to the cut will again assume the central leader position. The third step is to head back any strong growing laterals so that growth is balanced between all those remaining. Such heading cuts will induce secondary branching and continued extension growth of those laterals. Broken or damaged branches should be removed.

Third Spring: The central leader is again headed to a point where lateral branching is desired. The shoot from the bud adjacent to the cut will assume the central leader position in most cases. Shoots from lower buds normally develop into lateral branches. It is still essential to insert spreaders in appropriate places to spread the younger laterals. Strong laterals may again be headed back somewhat in order to balance growth around the tree. Undesired branches arising from the trunk may also be removed or headed back severely in order to dwarf them. It is essential to remove or head back branches that would interfere with proper development of desired scaffold branches. Very little, if any, thinning of secondary branches on the scaffolds is needed at this time. The scaffolds should be pruned only enough to maintain the balance of growth and pyramidal shape of the tree. The oldest scaffold branches should be forming fruiting spurs the third growing season on most spur-type trees and trees on dwarfing rootstocks.

Fourth Spring to Bearing: The central leader is headed back each spring, as explained previously, in order to induce lateral branching and promote growth of the central stem. Two or more laterals will usually develop just below the heading back cut. When the tree does reach the desired height, the leader is cut to a short lateral branch at this height. In succeeding years upright growth is removed annually from the top or is severely headed back in order to maintain the desired height.

When the desired spread of the tree is reached, scaffold branches are likewise headed back in order to curtail extension growth. Some thinning out of secondary branches is frequently necessary to reduce total growth of the scaffolds and to promote good light penetration.

A young bearing Golden Delicious tree that has been successfully trained to the central leader form.

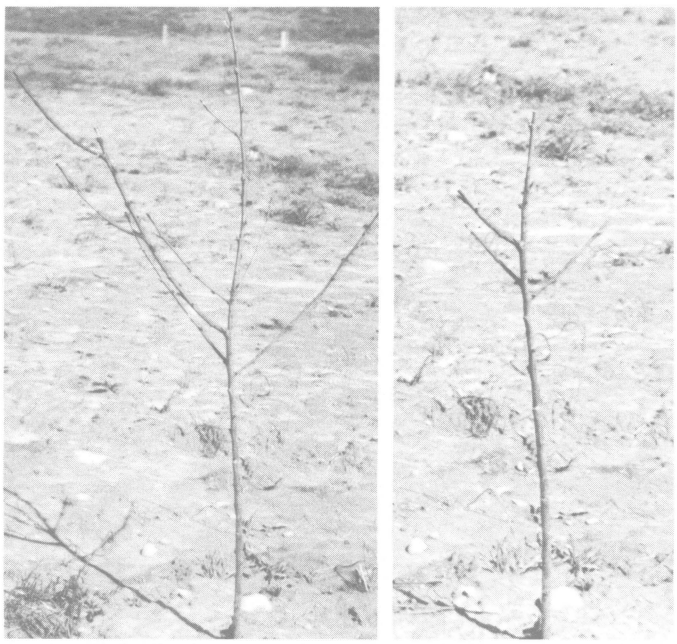
It is important to maintain the pyramidal tree shape throughout the life of the central leader tree. To do this, it will be necessary to promote maximum fruiting on all lateral and scaffold branches. This involves thinning out so that fruiting spurs near the center of the tree can receive good light exposure. In addition, upper lateral branches and scaffolds need to be headed back annually in order to maintain growth shorter than those lower on the tree.

Open Center System

This training system involves pruning techniques that result in the development of 2 to 4, preferably 3, scaffold branches arising near each other on the trunk. All scaffold branches are pruned so as to develop about equal in size, for spacing as equally as possible around the trunk, and to arise at a point 18 to 24 inches from the ground.

All kinds of fruit trees can be trained to the open center system, but it is especially adaptable to peach and nectarine trees. The training procedure, as described in the following paragraphs, is concerned with peach trees, but the steps will apply to other fruits as well.

Peach and other trees trained to this system in which the primary scaffold branches make wide angle crotches with the trunk possess a high degree of winter hardiness in the tree framework. Preferred crotch angles are those of 60 to 90 degrees. Bark and wood tissues in and around narrow crotches are usually quite susceptible to sub-zero temperature injury, especially if such crotches have considerable bark inclusion. Winter injured crotch areas are also more susceptible to disease infection such as peach canker and insect invasion, as in the case of the lesser peach tree borer. Branches with bark inclusions associated with narrow crotches often split out when under a heavy fruit load.



Peach tree at planting to be trained to the open-center form, left. Right, the same tree after pruning to leave 3 wide angled branches for scaffolds and a 2 to 3 inch stub in the center.

The immediate objective of this training method is to prune the tree in a manner that will induce growth of branches to form wide angles with the trunk. Steps in the pruning procedure are as follows:

At Planting: The 1-year-old tree is headed to a height of 28 to 30 inches. It is possible that the tree will have 1 or 2 branches already started which could be utilized as primary scaffold branches. If so, these are headed back so that only 2 or 3 buds remain on each. Preferably, such branches should arise from 2 to 4 inches below the point where the tree was headed. All other branches are removed. If no laterals suitable for scaffold branches are present, then all branches are removed.

June of First Year: By early June most buds on the tree will have developed into leaf rosettes or growing shoots. The most vigorous shoots usually arise from the uppermost 2 or 3 buds on the trunk, and often form much narrower angles with the trunk than do the lower shoots. Thus, they are often unsuited for developing into the tree framework. If shoots with such narrow angles are shortened to 2 or 3 inches, the less vigorous shoots below them but with more desirable angles, will be induced to grow more vigorously. If no shoots exist below those headed back, this severe pruning will usually cause buds to break and shoots to develop below them. From these can be selected the shoots to develop into the primary scaffold branches.

Three lateral shoots are generally selected to develop into the primary scaffold. Some trees may develop only one suitable shoot the first season while others may have several. Any shoots arising below the selected scaffold branches are also headed back severely, leaving only a few inches of growth. If one of the shoots left for a scaffold is overly vigorous and tends to dominate the tree, it should be shortened to bring it into balance with the other branches. The best framework results if all the scaffold branches grow at about the same rate.

Summer pruning of a peach tree in June of the first year. Left, before pruning; right, after removal of unwanted shoots and heading back shoot growth on stub in tree center.

It is necessary to go over the trees again 3 to 5 weeks later. At this time, over-vigorous shoots may need cutting back again to maintain balance of growth. Should additional scaffold branches be needed to complete the framework, these can be selected at this time.

Spring of Second Year: While the trees are still dormant, preferably in March, additional pruning cuts will be necessary for the training process. At this time, those branches remaining in the center above the primary scaffold branches should be cut back. Only short stubs should remain from which a small cluster of shoot growth will develop in the center of the tree the second season to help maintain the open center. Remove any growth below the scaffold branches at this time. Any growth arising on scaffold branches within 6 inches of the trunk or on the trunk should be removed at this time.

If, for some reason, the 2 or 3 primary scaffold branches could not be selected the previous June, they may be chosen at this time. All branches below the scaffold branches are removed, and those above are cut to short stubs as explained previously.

Avoid cutting the main scaffold branches unless necessary to maintain balance in the tree. If one scaffold branch

Left, the same peach tree as above in the spring of the second year; right, after pruning. Note the center stubby growth remains.

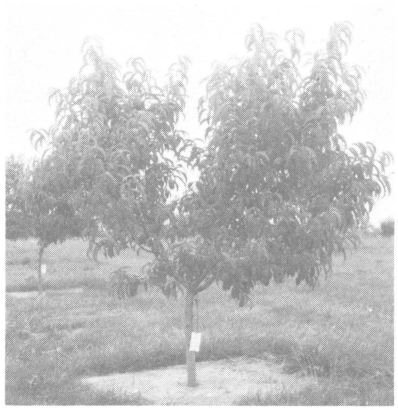
The center stubby growth is headed back so as not to compete with other growth of the tree.

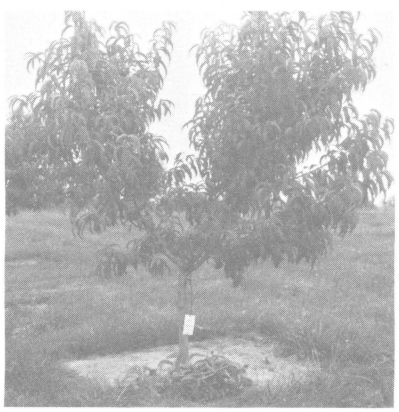
dominates the tree, it should be headed back to a size proportionate with the others. It is necessary to have all scaffold branches continue growing at approximately the same rate in order to maintain a well-balanced tree.

June of Second Year: Shoots arising from the stubby growth above the scaffold branches should again be cut back severely. Any growth arising from the trunk below the laterals should be removed. It may be necessary to do light pruning on scaffold branches in order to maintain tree balance.

Center Stubby Growth: If the tree has grown sufficiently to "shade out" the center stubby growth, prune it out completely. Should the stubby growth in the center still exhibit vigor, prune it back severely and leave for another growing season.

The only other pruning normally needed is corrective in nature—removal of branches with very poor crotches, branches growing through and across the tree, broken branches or those that show severe insect or disease injury.



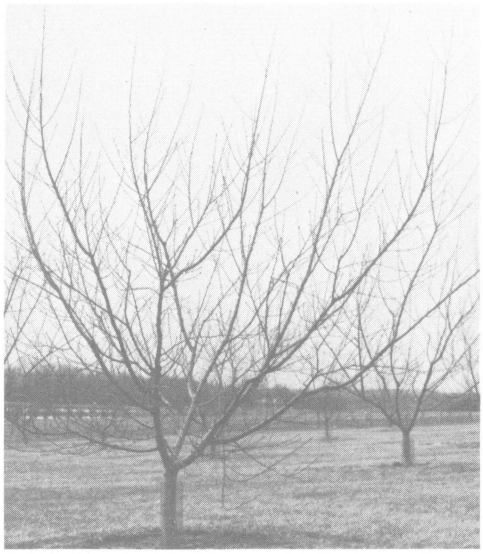


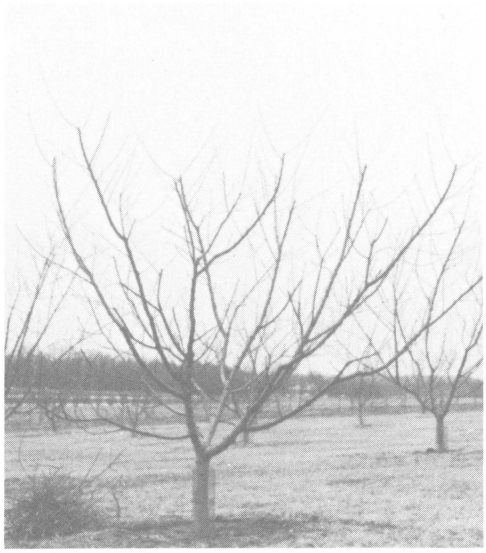
Pruning during June of the second year. Left, tree before pruning and right, the same tree after short growth has been removed from the center.

Moderate heading back of branches will be necessary in order to maintain a balanced, open-center tree form.

Removing Non-Bearing Parts: After the third season's growth, the permanent shape of the tree should be well established. Dormant pruning during this period will consist of light heading back where needed and removal of damaged as well as undesirable branches. Only sufficient pruning need be done to maintain the tree within desirable size limits. As the trees come into bearing, the weight of crops can be expected to open and spread the trees.

Peach tree in third year before pruning (left) and after pruning (right).





The same tree in its fourth year before pruning (left) and after pruning (right).

The same tree in its fifth year before pruning (left) and after pruning (right).

A satisfactory peach tree can be developed with only two wide-angled primary scaffolds. A 5-year old tree before(left) and after (right) pruning.

A mature 8-year old peach tree with good open center framework that is strong and less subject to low-temperature injury than one with narrow angles.

Special Training Techniques

Trellising: With the advent of size-controlling rootstocks for fruit trees and high density plantings, growers have become interested in trellis supports for fruit trees. This is especially true with apple cultivars on the most dwarfing rootstocks, Malling IX and Malling 26. Dwarf trees trained and secured to wire trellises have been established in commercial as well as home plantings. This method of growing apples can accommodate from 400 to 600 dwarf trees per acre, depending upon planting distances.

Training fruit trees to a trellis is quite similar to training grape vines to the 4 or 6 arm kniffin system. The trellis may be constructed to accommodate 3 to 6 or more wires, depending upon vertical spacings of the wires and the ultimate height desired. In most instances the wires are spaced 18 to 24 inches apart vertically with the bottom wire 18 to 24 inches from the ground. The height of the top wire will be determined somewhat by the harvesting method to be used. If all picking is to be done from the ground, the top wire would be 6 to 8 feet from the ground. If a picking platform or short ladders are anticipated, it could be 8 to 10 feet from the ground. The cost of available posts of the desired length would also be a determining factor.

Posts to carry the wires may be set before or after planting the trees, and spaced in the row between every 2 or 3 trees. The wires, usually No. 9, should be in place and secured firmly to the posts by the middle of the first growing season.

Training begins at planting. If no branches are present near the bottom wire, the tree should be headed at the height of the bottom wire. This will induce branching just below the wire. The uppermost new shoot usually grows in an upright position and assumes the position of a central leader. At least 2 other shoots will arise below this one. The 2 most suitable are tied to the bottom wire as soon as they are long enough, 1 in each direction. Any other shoots are cut back to short stubs. In tying a shoot to a wire, do not bend it downward to a level that the tip is at a lower level than the point of attachment on the trunk. To do so greatly retards extension growth. The shoot will be in the best position when the tip is a few inches higher than its base. Also, this position is less likely to induce vigorous risers on the scaffold.

Growth of the uppermost shoot should extend well beyond the second wire by the end of the first growing season. During dormant pruning the next spring, head back this central stem at a point just below the second wire. Again, branching will occur just below the cut. Tie 2 of the lateral shoots, as they develop, to the second wire—1 in each direction. Train the uppermost shoot to the central leader position. During the growing season, head back to short stubs any additional branches from the trunk. Short growths and spurs that bear fruit within 2 or 3 years will develop from these stubs. The branches trained to the lower wire need little pruning the second year, other than to maintain terminal growth and to prevent vigorous upright shoot growth. Strong upright growth is headed back severely so as to contain it well below the second wire. Pruning during the succeeding years of training will

Dwarf apple trees on Malling IX rootstocks trained to a wire trellis for support in a high density planting.

Delicious apple tree being trained to the wire trellis. Branches are bent down to near the horizontal position and secured to the wire with plastic ties.

Dwarf trees trained to a 4-wire trellis can be very productive in 3 to 5 years after planting.

be similar to that described for the second year until the basic framework is complete.

When the central leader reaches the top wire, 1 or 2 procedures may be chosen. The leader may be bent in one direction and tied to the top wire. Then, when a lateral shoot develops below the bend and becomes large enough, it may be secured to the wire in the opposite direction. The other procedure is to head the leader just below the top wire. When new lateral shoots develop, tie the 2 uppermost to the top wire, as soon as they have sufficient length, extending each in opposite directions. The latter method gives a little more assurance of adequate branches for developing into scaffold branches.

As the arms or scaffold branches on the wires reach the desired length—when one touches the tip of another, each will need to be nipped back lightly. Each year, pruning on the scaffolds should be limited to thinning out for good light penetration, heading back of vigorous upright shoots, and pruning side branches to maintain the desired width of the tree row, which is ordinarily 3 to 4 feet.

Mature plantings in the trellised hedge-row system require only a moderate amount of annual dormant pruning. It is often helpful to go over the planting in June or July each year and nip back or remove excessive or unwanted shoot growth. Such summer pruning helps greatly in maintaining tree size at a given level, as well as reducing the shading of lower branches.

Dwarf pear trees may also be trained easily to the trellis system. The various stone fruits may be trained to a trellis, but the procedure is more difficult because the growth habit of these trees does not lend itself to easy manipulation of branches. Spur bearing trees can be trellised more easily than can those which bear fruit on long shoots, as does the peach.

Apple and other fruit trees can be trained to various espalier forms as this one on the house wall.

Espalier: The training of fruit trees to grow in various forms, including picturesque shapes, on walls or other permanent structures is a technique of long standing in Europe and England. This method also makes it possible to grow fruit where the area is very limited, as on a small home lot.

Through proper pruning and fastening of shoots or branches in place, the grower may develop any design he desires. Following are a few general pruning principles that can be used in espalier training:

1. Head back central leader and branch terminals by cutting into 1-year wood at points where additional branching is desired.

2. Secure shoots in desired places the year they first develop; each year new shoots, as well as older branches, need to be secured in place and kept there until permanently formed to the shape. This may require 2 or more years.

3. Regulate growth of branches by summer pruning. In most cases this involves pinching back young succulent shoots so as to dwarf their growth. This practice is especially essential with shoots that tend to grow vigorously.

4. Each spring prune back the terminal growth of all branches to suppress extension growth and to induce spur development close to the primary arms or scaffold branches. Each terminal is cut so that 2 or 3 inches of the preceding season's growth remain.

5. As the espalier tree grows older and full of secondary branches, some thinning out of these branches and fruiting spurs will be necessary each year to maintain the shape as well as productiveness of the tree.

Pruning Bearing Fruit Trees

Pruning to maintain tree shape and size is necessary throughout the life of the tree. In addition to such maintenance pruning, young bearing trees do require some branch thinning to increase light penetration. The removal of large limbs should be unnecessary. Good soil management and fertilizer practices will maintain satisfactory terminal growth without producing an excessive amount.

Remove dead, diseased or damaged branches annually, regardless of tree age. Likewise, remove water sprouts each year except for an occasional one needed for developing new bearing surface. The best time to remove water sprouts is in early summer when they are soft and succulent. At this time they can be rubbed off easily with a gloved hand. If done after sprouts become woody at the base, shears will be necessary to prune them off. If removed in the summer, water sprouts seldom grow back, or if growth does occur, it will be small. Any water sprouts remaining on a tree can be removed during dormant pruning.

As trees grow older, an increasing number of heading back cuts are needed to maintain tree size and shape. Also, the amount of branch thinning may need to be increased to provide for development of good bearing wood through-

out the tree. Color of fruit produced the previous season is also an important guide to the amount of pruning needed. Poor color will, in many cases, indicate a need for more detailed pruning, particularly of the thinning-out type. Heavy pruning, however, may result in large, poor-colored fruits. This is very likely if nitrogen applications have been heavy. The rate of nitrogen application should be reduced in years when pruning is heavier than normal.

Annual pruning is recommended. When followed, only a moderate amount is necessary each year. One objective is to remove branches that are severely shaded and will bear few fruiting spurs. Remove branches that bend to the ground or head back to upward-growing laterals.

Annual dormant pruning of bearing trees helps to promote regular bearing. It also tends to reduce fruit overloads, as well as the labor expenditure for hand thinning. When pruning is irregular, trees become overthick and often biennial in bearing habits.

Apples

Apple cultivars differ in growth and fruiting habits. This means it is advisable to consider the growth habit of each one when developing pruning techinques. All standard strains or mutations of a given cultivar are pruned the same as the parent cultivar. Over color of fruits of the all-red mutations is good, but proper pruning is still essential for improving fruit size.

Cortland: Cortland trees develop many small branches, of which many need to be removed annually. This requires detailed pruning. Removal of slender, underhanging branches is very important as these produce poor-colored fruit and shade other branches and fruits. Larger branches may be thinned out by distributing several small cuts, beginning at the end of the branch and working to its base.

Delicious: Delicious and its various strains possess an inherent tendency to develop narrow crotches. Such crotches frequently develop bark inclusions which contribute to a weakened tree structure. Therefore, spreading, deshooting and corrective cuts, to space the most desirable branches along the trunk of young trees, are important procedures during the second to fourth years. Braces can be developed from intertwining water sprouts to help strengthen weak crotches.

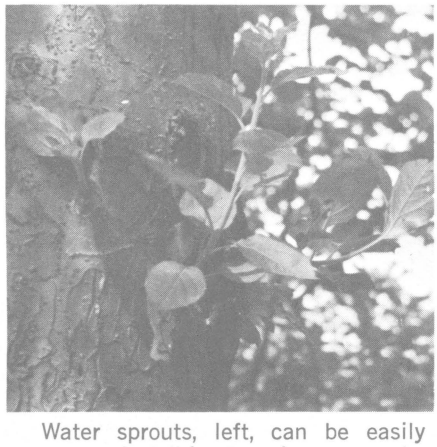
Delicious may develop too many medium-size branches, resulting in over-dense trees, unless wise removal of excess branches is carried out. Since this cultivar is planted primarily for fresh sale for eating, sufficient annual pruning is necessary to produce a high percentage of attractively colored apples. This means that trees must be kept reasonably open to permit entrance of sunlight. Removing small diameter and underhanging branches from both the interior and the periphery of the tree will allow light to enter.

Delicious has a somewhat precarious fruit-setting habit. Detailed pruning may improve the set of fruit. Fruit thinning is important with Delicious to secure a high percentage of large, well-colored fruit, particularly if pruning has not been properly done. Trees are also prone to produce an abundance of water sprouts. These are best removed as they develop early in the growing season.

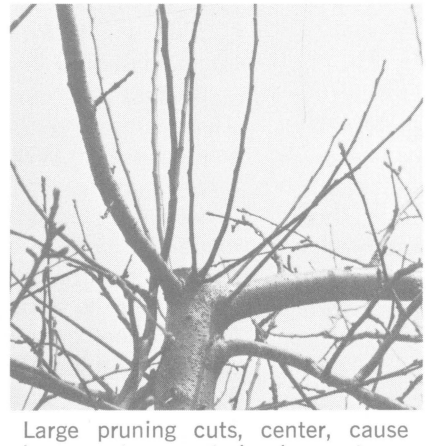
Franklin: Franklin tends to bear fruits throughout the tree in a pattern similar to McIntosh, one of its parents. If the tree becomes dense, a large percentage of the fruits will be small and poorly colored. Detailed, annual pruning, therefore, is essential to the production of highly-colored Franklin apples. Franklin's bearing habit, similar to McIntosh, makes it necessary to thin out rather heavily the centers of trees. Other pruning practices described for McIntosh also apply to Franklin trees. Pruning practices must be related to other cultural practices, particularly nitrogen applications, if well colored fruits are to be produced.

Golden Delicious: This cultivar is an early bearer. Consequently, tree form should be developed as early as possible. It is not difficult to develop a strong, well-shaped scaffold system on this cultivar.

Golden Delicious has a tendency to develop weak, narrow-angled crotches but much less so than that of Delicious. It is, therefore, necessary to develop a framework with wide-angled crotches. Developing branches often become long, and with the first heavy crop of fruit, they break because the wood of Golden Delicious is rather brittle. Pruning annually and keeping all branches within reasonable lengths is essential.



Water sprouts, left, can be easily removed at this stage in summer by rubbing them off with a gloved hand.



Large pruning cuts, center, cause heavy water-sprout development, especially in the tops of trees. These are removed or severely headed back in dormant pruning, if not rubbed off in the summer.

Older trees, right, can develop productive wood throughout the tree if proper training and pruning procedures are followed annually. Light in the center of the tree is essential for productive spurs.

Holiday: This cultivar is characterized by a vigorous, spreading type of growth. The major scaffolds are rather large in diameter and branches are of medium thickness. They are nearly as small as those of its parent, Jonathan, but resemble Macoun more closely. Bearing occurs rather early in the life of the tree and on both spurs and shoots. Branches form characteristically wide-angled crotches, even somewhat wider than Macoun. In overall appearance, the Holiday tree resembles that of the older Baldwin cultivar. Pruning should involve the thinning out of medium sized branches throughout the tree in order to produce fruits of a satisfactory size and of the best over color.

Jonathan: Trees of Jonathan naturally develop a dense fine growth. Unless properly pruned, bearing trees become thick and shading occurs throughout the tree. Jonathan does not respond well to heading-back cuts, thus detailed thin wood pruning and branch spacing is essential to good fruit size and color throughout the tree. This cultivar tends to be small fruited. If good commercial size fruits are to be produced, careful attention must be given to pruning practices.

Heavy pruning of Jonathan increases the hazards from fire blight, a disease to which this cultivar is very susceptible. It may also reduce fruit color. Nitrogen fertilizer should be restricted on Jonathan in order to improve fruit color and to reduce fire blight susceptibility. The heavier the pruning, the less nitrogen should be applied.

Lodi: Lodi is similar in growing habit to Yellow Transparent and should be pruned in a similar way.

This cultivar tends to set fruit heavily in alternate years, especially on the smaller wood in the center of the tree. Fruits produced in the shaded interior are usually of inferior size, green in color, and mediocre quality. Therefore, annual detailed pruning in the interior section is necessary to remove most of the thin wood which produces the inferior fruit. Branches in the outer portions of mature trees also need annual thinning out and some heading back of long branches.

McIntosh: The McIntosh cultivar naturally produces scaffold branches with reasonably wide-angled crotches, thus resulting in a spreading-type tree with many secondary branches. Therefore, considerable branch thinning is necessary to permit thorough spraying.

McIntosh tends to produce fruit spurs throughout the tree similar to Franklin and Golden Delicious. Thus, pruning to keep the tree open is important to producing well-colored fruit of good size.

Melrose: Melrose develops naturally a structural framework intermediate between its two parent cultivars, Jonathan and Delicious. It tends to form crotches of a somewhat wider angle than Delicious but narrower than those of Jonathan.

A relatively large number of medium size branches develop as the tree reaches bearing age. These are larger than those found in Jonathan but slightly thinner than those developing in Delicious. Consequently, pruning of the maturing tree requires removal of a number of these branches throughout the tree. This will permit entrance of sufficient light to encourage proper development of the attractive red over-color which Melrose fruits can have.

Since the fruits of this cultivar tend to become oversize, proper coordination of fertilizing, thinning and pruning is necessary.

Rome Beauty: Trees of this cultivar are characterized by many slender branches which cause much shading. Therefore, they require considerable thinning out. Each large branch is best pruned as a unit from the tip to the base. The cuts are distributed as evenly as possible, and weak wood is removed.

A common mistake in pruning bearing Rome Beauty trees is to start at the base of a large branch and prune outward, removing all the bearing surface for a considerable distance. This leaves a long stretch of barren wood with a cluster of unpruned bushy twigs at the end. If the full crop potential is to be gained, special care must be given to the placement of thinning out cuts on all strains of Rome Beauty trees.

Ruby: Trees of Ruby are prone to develop narrow-angled crotches. In this respect, it is similar to its two parents, Gallia Beauty and Starking. Therefore, in training the young tree, it is essential to use all possible methods in developing a primary scaffold with wide-angle crotches.

The growth habit of Ruby is intermediate between Gallia Beauty or Rome Beauty and Starking but more nearly resembles Gallia Beauty. Pruning mature trees is similar to that of Rome Beauty.

Stayman: This cultivar tends to develop many rangy, rather large branches. Consequently, heading-back and proper selection of primary and secondary branches are necessary on young trees. As a mature tree, Stayman is an open grower which requires few large branch removals. Corrective cuts, when necessary, should be made to avoid double leaders and weak crotches.

Stayman, especially if slow growing, develops some sharp-angled crotches. Making corrective cuts to eliminate these structural weaknesses before the branches attain large size is desirable. If necessary, water sprouts can be intertwined between weak crotches to make a natural brace and strengthen the framework. Because Stayman is an open grower, much of the pruning can be done with lopping shears. Small cuts, well distributed, give a large food supply to the remaining fruit spurs.

Turley: Turley, similar to Stayman, is a Winesap seedling and should be pruned similar to Stayman.

Wealthy: Red over-color is important with Wealthy. The pruning program should be such that trees never become dense. If Wealthy is allowed to overbear, it becomes a weak grower and a biennial cropper more quickly than if moderate annual crops are encouraged. It is important to do considerable thin-wood pruning throughout the tree in order to promote vigorous, productive growth. Pruning should also be sufficient to produce a considerable amount of new shoot growth. Pruning and fruit thinning are both important with Wealthy, thus neither practice can be substituted for the other.

Due to its susceptibility to fire blight, pruning, which induces vigorous growth, of Wealthy trees should be kept to a minimum on Wealthy trees.

Yellow Transparent: Trees produce many branches and may become very dense. When the main branches are well

spaced, weight of the fruit spreads the tree quite satisfactorily. Very little heading back to outward growing laterals is needed if enough large branches are removed in pruning. Small cuts, well distributed on branches which are left, help considerably to improve fruit size. The amount of thin-wood pruning is necessarily increased as trees grow older.

Yellow Transparent is greatly benefitted by pruning as well as by early fruit thinning. Since it is difficult to sell small fruits, both pruning and thinning are needed in a relatively high degree to improve size of this cultivar and to aid in overcoming biennial bearing. Over-pruning should be avoided since it induces succulent growth which is quite susceptible to the fire blight disease.

Pear Trees

Very light pruning is practiced on bearing pear trees. Even moderate pruning may induce development of water sprouts and fast-growing terminal growth. This type of growth is very susceptible to fire blight infection.

Pruning cuts may be restricted to branches that severely rub each other and to water sprouts as they appear. In all cases, cuts should be confined to limbs of small diameter. Heading back of terminals should be done only as the tree becomes too high. Heading back to a lateral branch at that time should be light and cuts made in the smaller diameter wood. It is usually not necessary to prune pear trees each year because new growth should not be heavy or vigorous. However, each year the trees should be examined to determine if pruning is necessary.

Remove Blighted Branches: During dormant pruning, remove all fire blight infected branches. Blight cankers can be detected by their dead, blackened and sunken appearance. Blighted terminals are blackened and often retain the dead leaves through the winter.

Beginning shortly after bloom, inspect trees weekly until midsummer for shoots and spurs that may be infected with blight. Promptly remove the diseased portion 4 to 6 inches below the obviously injured part and carefully disinfect the wound. A satisfactory disinfectant may be made by mixing 1 part bichloride of mercury (poisonous) and 1 part cyanide of mercury (poisonous) in 500 parts of glycerine. Some dye may be added to make the treated points identifiable.

Water sprouts, short growths, and spurs on the trunk and base of scaffold branches should be removed prior to blooming. This will eliminate possible blight infection of flowering points at the terminal ends of these spurs and short growths, thus preventing blight development which will often girdle the trees.

Peach and Nectarine Trees

Peach and nectarine trees are pruned alike. Annual pruning of bearing trees is essential to the production of fruiting wood and high yields of quality fruit. Flowers of these trees are formed only on terminal growth, thus proper pruning will aid in the production of good fruiting wood. This becomes particularly important as the trees become older. Pruning the bearing tree must also be done to help in pest control and to provide for favorable light conditions throughout the tree. Pruning, judiciously performed, can reduce overbearing, the amount of fruit thinning needed, and hence improve orchard efficiency and the quantity of marketable fruit produced.

Time of Pruning: Pruning of peach and nectarines should be delayed until the danger of severe freezes is past. Generally, pruning should be done from mid-March to early April. It should not, in normal seasons, be delayed so long that buds might be knocked off in the pruning operation. If severe winter temperatures have been experienced, delayed pruning may be especially beneficial. By delaying pruning, one can avoid the removal of buds which have survived. Winter injured flower buds can be identified in late winter or early spring by the characteristic dark centers when cut in cross-section. Wood that has been injured by low temperature will appear "wrinkled" or withered and when cut will show a brown layer of tissue under the bark. Such wood can be easily detected and removed by early spring.

Mature peach trees need annual thinning out and heading back to induce development of new productive wood.

Pruning Procedure: Peach and nectarine trees that have reached bearing age require annual heading back and careful thinning out. In addition, all damaged or diseased wood should be removed as well as that growing in an objectionable direction. Also, remove hangers, branches that grow downward, and branches that interfere with the movement of equipment through the orchard. In general, trees should be pruned to the extent that fruit can be harvested handily from a six-foot ladder. When thinning out of branches is done, distribute cuts over the tree so as not to leave a cluster of twigs at the ends of branches.

The "horse-tail" effect can be avoided when pruning proceeds from the tip to the base of each scaffold branch.

Vigorous, upright sucker growth frequently develops in peach and nectarine trees. It is most abundant following severe pruning or loss of large limbs. Such growth may reach 5 or 6 feet and may present a special problem. Most suckers need to be removed completely during dormant pruning, but a few may remain for developing into new fruiting wood. These are headed back to an outward lateral branch, with some thinning out of the remaining laterals. So handled, they may develop into fruiting wood replacing that which was lost or pruned away.

To maintain the trees at the desired height, it is important to head the upward growing branches to strong, outward growing laterals. It is preferable to make the cut at a height one can reach easily with lopping shears or a short pole pruner while standing on the ground. The renewal point is first established by heading back each main branch as soon as it reaches the desired height. This cut is ordinarily made in one-year-old wood. In succeeding years the renewal cuts are to be made in the vicinity of the original cut, some years above and some years below it.

Whenever possible, prune from the ground, hence the reason for keeping trees low. New shoots ordinarily develop near the renewal cut. The best of these can be used for fruiting wood the following year and others removed. The center of the tree is kept reasonably open in order to maintain the spreading form.

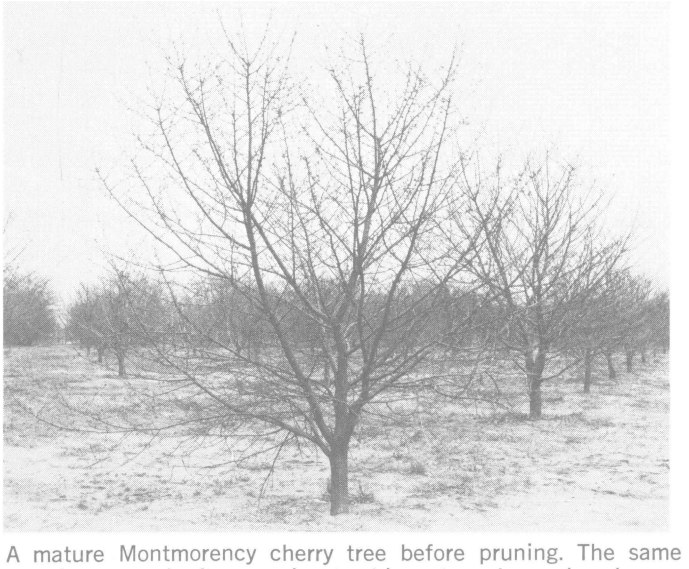
Avoid climbing in peach trees while pruning, especially with hard soled shoes. The bark can be easily scuffed, which results in open wounds where canker infection can take place. If trees are too tall to be pruned from the ground, it is best to prune from ladders.

Severe heading back, or "dehorning," may on occasion be acceptable. It most logically fits into the pruning program after trees have been allowed to grow rather tall from lack of pruning in years when frost damage occurred and crops were borne only in the upper parts of the trees. When such trees have a complete crop loss, the severe heading back or dehorning may be the best way to induce new shoot growth lower on the trees and thus increase bearing surface for the next year.

Height of mature peach trees can be controlled by annual heading back of upright growth.

Peach Canker Removal: The peach canker disease presents some special problems in pruning peach and nectarine trees. Complete removal of a canker infected branch is necessary when the canker is near its base. When the canker area is farther out on a branch, the cut should be made 6 to 8 inches below the visable canker edge. In any case, cutting through a canker should be avoided. If cuts

Proper pruning is essential to control of peach canker disease. Cankered branches should be removed, as the one on the left with a canker near its base.



A mature Montmorency cherry tree before pruning. The same tree (next page) after pruning to thin out weak wood and open up the tree for good light penetration.

are made through a canker, then the disease organism may be transmitted to healthy wood at the next cut by way of the shears, unless the shears are disinfected between cuts. Prunings with diseased wood should be removed from the orchard and buried. Pruning out of cankered branches should be as complete as possible if this disease is to be kept at a minimum in the orchard. Where canker is a problem, prune as late in the spring as possible. This avoids wounds that are points of easy entry of the pathogen in early spring when the organism is most active.

Red Tart Cherry Trees

Since the modified-central-leader system is usually preferred in training red tart cherry trees, bearing trees are pruned to maintain this shape and for high production of quality fruit. Trees that have been trained to 3 or 4 pruning scaffolds are equally satisfactory for mechanical harvesting as for hand picking. There is little difference in the performance of cherry trees when trained to the modified-central-leader system or to the open center system.

Characteristically, the red tart cherry tree tends to produce narrow angle crotches. Trees tend to open up with the crop, but the use of spreaders in young trees may be helpful in developing a strong tree framework.

The red tart cherry tree tends to produce a dense top which requires an increasing number of thinning-out cuts in order to keep the trees open. Unless special attention is given to these trees, the fruiting wood in the lower interior portions will shade out and perhaps die. Since the trees have a spur bearing habit, care must be exercised so as not to remove this portion of the surface when thinning out. Such limbs can severely shade the lower portions and may cause limb rub damage to main scaffold members, hence these should be pruned out each year. Occasional cutting back of upright wood to outward laterals is necessary on the main branches.

Mature red tart cherry trees perform best under light, annual pruning. Remove dead wood and broken branches as they appear as well as cross growing branches. With well grown trees, some thinning-out pruning is necessary to aid thorough pest control and to make harvesting easier.

Sweet Cherry Trees

The sweet cherry tree develops into a large tree. The modified central leader system of training, as described for the apple, is most desirable for the sweet cherry tree. Three or 4 primary scaffold branches with 8 inches or more vertical distance between them and with proper spacing around the trunk are desirable. The sweet cherry tree is occasionally injured by low winter temperatures, and the injury is usually greatest in the areas of narrow crotches. Therefore, special attention must be given to avoid narrow crotches in selecting the primary scaffold branches.

After the primary scaffold branches have been selected, care should be used in the selection of secondary branches with wide angles. These are likewise an important part of the tree structure and should not be developed closer than 15 to 18 inches from the trunk. Thinning-out cuts are essential as trees grow older. When the leader reaches the desired height it should be headed back to an outside branch.

Because of the natural tree size, sweet cherry trees, particularly on Mazzard rootstocks, are difficult to maintain much less than 16 to 18 feet in height. The trees require only light annual pruning. The primary objective here is to remove dead, broken and weak branches, especially those in the center of the tree. As trees grow older, it may be necessary to head back branches when they become too long. Such a procedure should help to develop new fruiting wood near the center of the tree and may also prevent limb breakage.

Plum Trees

A well-pruned tree is especially important in the spraying operation for the control of brown rot in plum orchards. European plums, such as Reine Claude, Italian Prune, German Prune, Bradshaw, Imperial Epineuse, and Stanley, are best pruned and trained to the modified leader, as described for apples. Selected scaffold branches on the plum tree may be closer vertically than with apples. However, about 6 inches of vertical spacing between scaffold branches is desirable.

Lighter pruning may be followed with European and Damson plums than with apples. As trees reach heavy bearing, there is reduced growth of terminals and increased growth of fruiting spurs. At this time, the amount of pruning may be increased. Detailed pruning throughout the tree and enough thinning-out to maintain desirable growth over the lower branches is recommended for mature trees.

Cultivars of the Japanese-type plums such as Methley, Formosa, and Burbank grow in a more spreading fashion than European plums. The trees also tend to grow thicker. Thus, training young trees and pruning mature trees are similar to those of the peach, except that fewer heading-back cuts are generally required than with the peach. Considerable thinning-out of small diameter wood in mature trees is necessary to maintain production of large size plums.

Removal of Black Knot: Pruning is the most important means of controlling the Black Knot disease of plum. Branches with these canker-like growths, generally of brown or black color, should be carefully cut from the trees and removed from the orchard. Twigs or branches with the characteristic swelling or knots may be removed any time the infections are first noticed but most certainly cut out during dormant pruning. Cut the branch off 6 or more inches below the apparent knot to be sure all infected tissue is removed.

The black knot disease of plum can be partially controlled by pruning out affected branches as shown by dotted lines.

Apricot Trees

Apricot trees are best trained to the open-center system as described for peach trees, but the modified-central-leader system can also be satisfactory.

With young as well as mature trees, long, slender branches require some heading back to laterals that are growing in an outward direction. Trees should be kept open with considerable thinning-out pruning in order to induce annual formation of fruit-bearing wood. In the case of the apricot, fruits are borne on short spurs that are rather short lived. A primary objective is to remove those branches loaded with spurs that are 6 years old or older. Annual heading-back and thinning-out will help assure formation of young, productive spur growth.

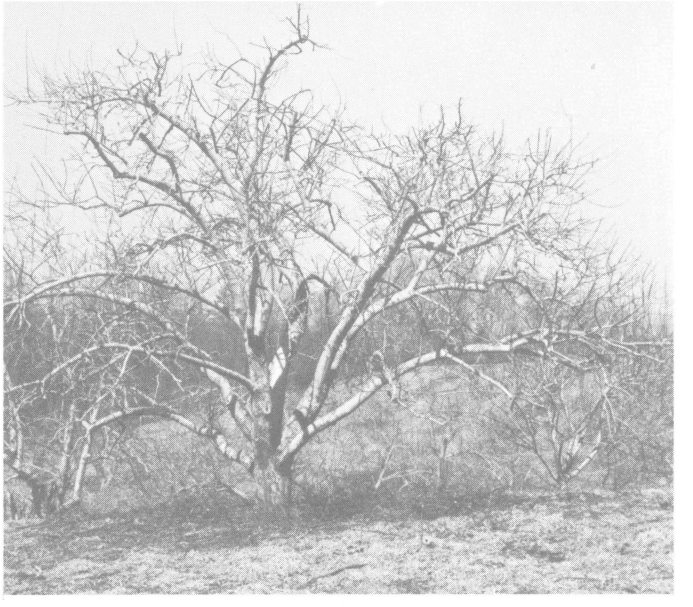
Apricot trees that are neglected and produce short annual terminal growth often fall into a biennial bearing habit, producing a heavy crop of small fruits one year and a light or no crop the next. To overcome this, pruning and fertilizer programs should be coordinated so as to result in 16 to 24 inches of terminal growth annually.

Apricots bloom very early; consequently, all or most of the flowers or young fruits are frequently killed by frost. Delaying pruning until after bloom may be advisable with apricots.

Quince Trees

Young quince trees may be trained to any system described for other fruits in this bulletin. Since the quince tree is naturally of spreading habit, it is easily adapted to the open-center system and is most frequently trained in this manner.

Quince fruits are borne terminally on short shoots that arise from terminal or lateral buds which were formed on the previous year's growth. Some apple varieties such as Rome Beauty produce a similar type of fruit-bearing wood. Because of this type of growth, the natural quince tree is



Pruning a neglected apple tree can aid in bringing it back into useful production. The tree at left was partially pruned, as shown in picture at right, in one season. Heavy pruning should be carried out over 2 or 3 seasons.

best pruned by a detailed thinning-out process. The degree of pruning, however, should be light, as advised for the pear, since fire blight is also a serious hazard in quince production. Pruning can be done at any convenient time during the dormant or delayed dormant season.

Pruning Neglected Trees

On occasion it becomes necessary to prune fruit trees that have been neglected for a period of years. The situation is often confusing to the pruner when he approaches a tree that has overgrown its desired bounds, is too tall, overly dense, and unproductive in a large portion of its interior. The primary pruning objectives with such trees are to reduce tree height and to thin out branches. This will permit good light penetration throughout the tree and assure better spray coverage as well as fruit production.

A suggested procedure for pruning a neglected tree is as follows:

1. Lower the height of the tree where necessary. Up to 4 or 5 feet of growth can be removed in one year. If it is necessary to remove more top growth, spread the pruning over 2 or 3 years, removing 3 to 5 feet of the older wood each year. Most of the water sprout growth in the tree top, resulting from the previous year's pruning, will be removed with the older growth taken out. The final cut in the top should be just above an outside lateral branch. Subsequent pruning in the tree top will consist largely of annual water sprout removal.

2. Remove undesired, large (over 2 inches diameter) branches from the interior of the tree, if necessary. It is usually best to remove all branches at once rather than distributing the cuts over a period of years as in top removal. However, if more than 4 large branches must be removed, remove half one year and half the next.

3. Prune off low hanging branches and dead, diseased or broken branches wherever they exist in the tree.

4. Head back lateral branches that are too long, bringing the tree to a desired breadth. Prune upper branches to shorter lengths than those lower on the tree.

5. Thin out branches in all parts of the tree. Remove underhanging branches, strong upright growing shoots and water sprouts as well as other weak growth. Thin the outer areas of the tree first and the interior last. This procedure permits the pruner better vision so he can leave some bearing wood near the center of the tree and avoid leaving all the bearing surface in the tree's periphery. The amount of thinning-out pruning will be determined by the original density of the tree. It needs to be sufficient to permit some light penetration to the center of the tree when in leaf. Light is necessary to the regeneration of fruiting wood in any part of the tree.

6. Complete rejuvination of a neglected tree may take 1, 2 or 3 years of rather severe pruning, as indicated in the previous paragraphs. For apple and pear trees, it is usually best to distribute the pruning over 2 or 3 years, especially when large cuts are needed. Peach, plum and cherry trees can often be completely pruned back and thinned-out in 1 year.

7. Follow annual, moderate pruning once the tree has been rejuvinated.

PRUNING TERMS

(Terms are defined primarily as they are used in the text of this bulletin.)

1. Bearing tree—a fruit tree that has reached the age of capable producing fruits annually.
2. Branch—a shoot that has developed to maturity and has passed through one or more dormant seasons.
3. Bud—the initial of an unelongated branch or tip of a shoot. A bud may develop into leaves or a vegetable shoot, or into flowers and their subtending parts. It may be terminal as at the end of a branch or shoot, or lateral as in the axil of a leaf.
4. Bud Union—the point of attachment between the scion cultivar and the stock or rootstock upon which it is budded or grafted.
5. Crotch, crotch angle—the angle between two contingent shoots or branches near the point of their union.
6. Cultivar—a term that is now used in place of the older term, variety, when designating a specific horticultural variation in a plant species.
7. Deshooting—the practice of removing young shoots from a tree or other plant during the growing season for the purpose of aiding in the training of the plant.
8. Disbudding—the removal of dormant buds, a practice sometimes followed on newly planted or young trees in the selection of buds for development into scaffold branches.
9. Dwarf tree—generally, a cultivar that has been propagated on a size controlling rootstock, as Malling IX, in the case of an apple or quince and produces a small sized tree.
10. Espalier—a wall or framework upon which a tree or other plant may be trained; or, the shape to which a plant is trained to be more or less picturesque as well as productive.
11. Fruiting wood—branches of a tree or other plant plant carrying flower buds and the potential for bearing fruit.
12. Growth regulator—a chemical substance that may inhibit or accelerate vegetative growth, or may affect the initiation of floral or vegetative buds, or in some way may alter the normal growth habit of the plant; the substance may occur naturally in plants or it may be formulated and applied to plants for the purpose of producing desired effects upon growth habits.
13. Heading back—usually refers to cutting away a portion of the terminal growth of a branch; it may be an upright branch or one growing laterally.
14. Hedging—a term applied to pruning by mechanical devices which cut away, in bulk fashion, portions of the tops and sides of trees.
15. Malling rootstocks—a group of rootstocks classified at the East Malling Research Station in England so that they represent various degrees of size control of the trees of cultivars propagated on them.

16. Old Wood—in pruning, this refers to branches that have been productive or bearing for a number of years, generally for more than 5 or 6.
17. One-year wood—wood or branches that were produced by the previous season's growth; a term generally used during the dormant pruning season.
18. Pome fruit—fruits are classified into specific types according to structure; the pome fruits are all similar in structure, although appearances may be quite different, are represented by the apple, pear and quince.
19. Rootstock—the root system and portion of attached stem upon which another plant part is propagated (budded or grafted).
20. Scaffold branch—one of the branches comprising the basic framework of a tree or other plant; primary scaffolds are those arising directly from the main trunk of the tree.
21. Semi-dwarf tree—a cultivar which has been propagated upon a specific size-controlling rootstock that produces a mature tree somewhat smaller than a standard tree and somewhat larger than a dwarf tree; rootstocks most often used for this purpose are Malling VII and II, Malling Merton 106, 104 and 111.
22. Shoot—vegetative growth produced from a dormant bud which prossesses leaves; generally, the growth developing during a current season.
23. Spreader—a short piece of wood or metal used to insert between a lateral branch and the main trunk of a young tree for purposes of producing a more horizontal growth habit of the branches.
24. Spur—short, thick growth upon which flowers and fruits are born, typically on most apple, apricot, cherry and pear trees.
25. Spur type tree—most often used in reference to recent mutations of certain apple cultivars that produce fruiting spurs earlier in the life of the tree and more abundant per foot of branch-growth.
26. Standard tree—commonly refers to a tree that has been propagated by grafting or budding a cultivar on a seedling rootstock.
27. Stone fruit—a specific type of fruit classified according to structure; refers primarily to peaches, plums, apricots, cherries and similar fruits with a story layer surrounding the seed.
28. Sucker—a rapidly growing shoot arising from a larger branch, usually from a latent bud; also refers to shoots arising from the rootstock below the bud or graft union.
29. Thin wood—refers to branches of rather small diameter in relation to overall length; these usually develop in the more shaded portions of a tree and from the lower sides of larger branches and are generally unfruitful or produce small, poorly colored fruits.
30. Thinning Out—refers to the removal of branches in a portion of the tree or throughout the tree or other plant for purposes of permitting greater light and spray penetration into all areas of the plant.
31. Water sprout—a term applied to vigorous, succulent shoots arising indiscriminately and generally on the larger branches of a tree; they are often produced in large numbers just below a pruning cut.
32. Whip—a single, unbranched shoot that has developed from budding or grafting a cultivar on a rootstock and grown one year in the nursery row.
33. Wound—the cut surface remaining on the plant where a branch has been removed by pruning; it may also refer to any other open surface on the plant.
34. Wound dressing—a proprietary compound especially made for treating cut surfaces on plants for purposes of reducing the drying of the exposed plant tissues and protecting the open areas from invasion by infections infectious organisms.